ARCHITECTURAL EPISODES 03: INNOVATION, TECHNOLOGY, DIGITAL TRANSFORMATION AND THE FUTURE OF THE CONSTRUCTION INDUSTRY

INTERNATIONAL SYMPOSIUM

ABSTRACTS

BOOKLET

Focus Theme

Industrial Revolution is considered an important turning point in human history, influenced technological developments, which inevitably continued over the years. The technological developments accelerate and progress in many industries and today it is still developing with new generation advanced technologies. Construction industry is one of the industries affected by technological innovations that emerge with industrial revolutions, since it has a dynamic nature and is the driver for the economic development of every country to a great extent. Construction industry has the power to influence other areas which is the other reason why development and innovation is important. Adaptation to the developing world with new technological development and the use of new technologies is of great importance for the construction industry. This importance has necessitated this symposium on the use of new technologies in the construction industry. Based on this point, the idea was to bring stakeholders together and discuss the future of the construction industry from today to tomorrow.

Through sessions effects of technological developments will be discussed with the goal to better understand the present and future of the architecture, engineering and construction industry. With this aim we invite papers addressing topics that may include but are not limited to the following:

- Current Approaches in Construction and Design
- Innovation in Construction and Design
- 3D Construction
- Performative, Adaptive, Interactive Designs, Artificial Intelligence, Generative Systems
- Education in Digital Era
- Digitalization in Construction and Design
- Digital Modeling – Digital Fabrication
- Building Information Modelling
- Artificial Intelligence and the Future of the Architecture and Construction Industry
- Alternate Realities (Extended Reality, Augmented Reality, Virtual Reality and Mixed Reality)
- Metaverse in the Construction Industry
- The impact of technological advances on sustainability and climate change

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1ST SESSION

SESSION CHAIR: ASSOC. PROF. DR. ALTUĞ SARIYAR

In Architectural Education Personalized Learning Experiences with Artificial Intelligence

Furkan GÖKTEPE[1], Zehra KEZER[2], Yasemin KAYAASLAN[3], Havva ALKAN BALA[4]

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Abstract

During the architectural education process, students are trained in technical knowledge, design processes, creative thinking, and offering solutions to diverse problems. New approach using AI based to needs of architectural students, would be obviously more effective than existing general and present architectural education. At this point, Artificial Intelligence (AI) come out as a supportive tool that provides an innovative approach to the educational process by creating functional and various methods. This study examines the potential of AI in architectural education and explores how personalized learning experiences can be made possible. Due to its complex and multidisciplinary fundamental, architectural education requires innovative methods that can provide to personal learning steps and needs. In this context, AI stands out as a powerful tool that supports student-based approaches.AI-based learning systems analyze student behaviors to offer content adept to individual learning styles. For sample, if a student needs more support in 3D modeling during the design process, AI algorithms can detect this need and suggest appropriate resources or provide guidance. AI can also offer tools such as virtual assistants, chat bots, or augmented reality applications to enhance interaction with students. These tools provide continuous feedback on students' projects, accelerating learning processes and creating a more interactive learning environment. Personalized learning experiences enabled by AI focus on students unique learning speeds, conditions, strengths, and weaknesses, offering a custom-defined approach that is expected to make architectural education more effective. AI tools included in this process can adapt in real time, providing responses under suitable conditions for students and assisting in enhancing their learning experiences. Through the data generated in collaboration with students and AI, the analytical monitoring of the process's functioning and its contribution to learning experiences can provide insights and help create an optimized system to increase its impact. In this study, simultaneously usable chosen AIs varies for their specializations. Design Process Tools (MidJourney, DALL-E, ChatGPT), technical tools (Revit, Adobe Firefly), structural analysis and simulation tools (ANSYS, ETABS, Ladybug), educational feedback tools (Copilot for Design, Turnitin Ai Writing), presentation and visualition (Lumion and Endscape extensions), data analysis and educational content (GAN and Notion AI) used in this study In this context, AI tools that could grants to architectural education have been identified, and comparative observations have been made to support personalized learning experiences. It is recommended that proposed AI tools actively participate in learning experiences. Among the suggestions, it is highlighted that AI capable of generating new designs and solutions in real-time, addressing challenges in architectural education, and adaptable students' diverse perspectives should play an active role. The findings of this study, focusing on personalized learning experiences, underline the importance of utilizing AI to advance architectural education.

Keywords: *Artificial Intelligence, Architectural Education, Personalized Learning, Architecture and Artificial Intelligence, Learning Experience*

3D Graphic Statics for Optimal Architectural Form and Structural Design

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Abstract

Graphic statics method has been utilized by architects for shaping innovative architectural structures since the 19th century, serving as a visual tool to illustrate the relationship between a structure's "form" and the "forces" it generates. In the 21st century, with the assistance of digital technologies, this approach has evolved from a two-dimensional analysis of thrust networks and force polygons to a three-dimensional exploration of thrust networks and force polyhedron. The objective of this study is to apply this approach to a structural form experimentally, focusing on achieving an optimal configuration to showcase the potential of the graphic statics form-finding method in developing structural forms that experience pure tensile or compressive stresses without relying on complex numerical calculations. This study employs a descriptive and analytical approach, beginning with a comprehensive literature review. It then proposes a design strategy to identify complex funicular spatial forms in pure compression (or tension) by constructing force diagrams through the aggregation of convex polyhedral cells and examining the generated forms.

Keywords: *3D Graphic statics, Structural form-finding, Computational Structural Design*

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Examining the Use of Artificial Intelligence in Architectural Visualization Tools

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Abstract

Throughout human history, Architectural representation tools have helped to percept two and three dimensions of architectural design products before the construction. However, the profession of architecture and architectural representation have changed over time due to technological developments and the use of new presentation and design tools.

Today, with the widespread use of computers, firstly vectorial, then three-dimensional drawings, and finally the possibilities in visualization by artificial intelligence, have brought about a rapid development in the profession of architecture and its representation. Until very recently, architects used to make their drawings and models by hand, but today they prefer digital presentation techniques, which play an active role in shortening the design and presentation process. However, the development and rapid spread on artificial intelligence, has brought about a new process. By entering the data, architects can obtain architectural visuals in a very short time.

Therefore, the main research topic of this study is coming from the question of whether artificial intelligence visualization tools can replace two- and three-dimensional photorealistic visualization tools, which require the physical presence of architects. This study also aims to find an answer to the question “Could the development of artificial intelligence applications in the field of visualization cause architectural visualization experts (architects) to lose their professions?”

In the context of this study, we considered a research study, which examine the impact levels of artificial intelligence visualization tools, and photorealistic visualization tools on the architectural project process and in which place, architects can use them effectively. We will evaluate the images produced by artificial intelligence visualization tools and photorealistic visualization tools by using a quantitative comparison method. Firstly, with the help of search on literature, we will generate parameters to determine and compare the photorealistic visualization tools against artificial intelligence visualization tools. Our first

group of parameter refers quantitative accessibility. We will determine the economic accessibility of digital tools by obtaining data on fees and/or discounts. Second group of parameter refer utilization properties. We will find out the library and editor status of each tools and examine the user's permissions on tools. And the third group of parameter is about the process of generating the image. We will determine the features and capabilities of the tools in creating the final images.

After all, we will use these parameters with different scales, to determine with the FIS Editor of the MATLAB tool. For making classification and rating about artificial intelligence tools, we will process each scale of parameters into a fuzzy logic system by using tables. Then, by uploading the image or model to the visualization tools, we will generate realistic images. With help of these classifications and correlations, we will examine in which areas photorealistic visualization tools and artificial intelligence visualization tools are strong, whether they can replace each other and in which areas and stages, we can use on architectural profession. We will find out the proficiency levels of each tools and evaluate the future of architectural visualization work from a professional perspective.

As a result, in addition to answer and offer suggestions for the use of artificial intelligence in architecture. This study can also form a basis for new research in the future to determine the effects of artificial intelligence visualization applications on the architectural project process and the architectural profession.

Keywords: *Artificial Intelligence; Architecture, Visualization; Tools; Architectural Digital Tools*

From Digital Real-Time Sketching to Interior Design: A Study on Prompt-Enhanced AI Generation

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Abstract

This study aims to evaluate the performance of the text-to-image AI platform Leonardo.ai, which utilizes a real-time canvas feature to generate images based on user-provided sketches and descriptive prompts, focusing on its application in interior design. The primary goal is to assess how effectively the model balances the representation of design styles from classical and contemporary design movements, sketch adherence, and functional requirements when creating living room designs.

The research systematically compares six distinct design styles—Art Deco, Romanesque, Renaissance from the classical period, and Modern, Futuristic, and Pop Art from the contemporary period—at three AI creativity levels (0.60, 0.75, and 0.90) to assess how real-time sketching and prompt enhancement influence design accuracy and creativity. In this study, AI creativity levels determine the extent to which the generated design deviates from the provided sketch and prompt. The closer the creativity value is to 1, the more the AI relies on its own interpretation, often diverging significantly from the original input to produce a highly creative, independent visual. Conversely, when the creativity level is below a certain threshold (e.g., 0.5 or lower), the AI adds minimal detail and closely replicates the sketch without significant enhancements.

The prompts and sketches were deliberately simplified to include only essential design elements: the space's function ("living room"), an environmental detail ("see blue sky from the windows"), and the specified design style ("a [style name] interior, living room, see blue sky from the windows"). The same simple sketch, resembling something even a child could draw, was used for all prompts to maintain consistency and evaluate how well the AI could interpret minimal visual and textual input.

In our early attempts with more detailed sketches, the AI primarily enhanced the presentation rather than demonstrating independent creative synthesis. However, this study aims to measure the AI's ability to synthesize simple sketches with brief descriptive prompts and leverage its creativity to generate cohesive and functional living room designs.

The AI-generated outputs are evaluated based on four criteria: “style compliance”, “prompt compliance”, “sketch compliance”, and “understanding the function of the space which is living room”. Each image is scored on a scale from 1 (poor compliance) to 5 (excellent compliance), providing a quantitative assessment of the model's performance.

The findings indicate that as creativity levels increase, the AI-generated designs become richer in stylistic details and more visually dynamic. However, this often results in deviations from the provided sketch, as the model introduces decorative elements that prioritize aesthetic complexity over spatial accuracy. Conversely, lower creativity levels produce more structured and predictable outputs that adhere closely to the sketch but lack the distinctive visual impact associated with their respective styles. Despite these variations, the model consistently maintained the living room function across all creativity levels, preserving key spatial features such as seating arrangements.

This study highlights the potential of real-time interactive tools in enhancing design processes by allowing users to guide AI-generated outputs through both visual and textual inputs. Future research could expand the scope by comparing multiple AI platforms, exploring additional room types, and incorporating user feedback on the aesthetic and emotional impact of AI-generated interiors. Such studies could further inform the development of more adaptive and user-driven AI tools for interior design.

Keywords: *Interior Architecture; Interior Design; Design Styles; Artificial Intelligence in Design; Sketch-Based AI Generation*

2nd SESSION

SESSION CHAIR: ASSOC. PROF. DR. GAMZE ALPTEKİN

The Effect of Roof Configuration on Wind Flow in Buildings with Integrated Wind Turbines

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Abstract

The rapid increase in population worldwide, coupled with the growing energy demands to meet these needs, has led to a significant consumption of energy through various technologies. The reliance on fossil fuels for energy has contributed to environmental pollution and increased carbon emissions, leading to global warming and an energy crisis. In this context, the use of renewable energy has emerged as an important solution today.

Among renewable energy sources, wind energy stands out as an environmentally friendly and sustainable option. There is a strong relationship between global warming and building energy performance because buildings worldwide are major energy consumers, contributing to global warming through their energy consumption. Therefore, ensuring energy efficiency in buildings and reducing energy consumption is a critical step in mitigating environmental impacts.

Initially, wind turbines were used for energy generation in independent turbine farms, but with the advancement of turbine technologies and international decisions aimed at promoting sustainable energy use, wind turbines have gradually been integrated into buildings. As a result of technological developments in the construction sector, the production and use of integrated turbines in buildings has increased. These developments have led to the production of smaller and lighter turbines.

Today, buildings with integrated wind turbines have become a common research topic, especially in international literature, and the number of studies on this subject has increased over time. The purpose of this research is to identify the factors that affect the wind performance of buildings in the context of the relationship between buildings and wind turbines. Based on the analysis of the existing literature, the formal characteristics of building surfaces that influence wind performance will be identified to maximize the efficiency of wind energy.

The literature review reveals that wind flow analysis, wind tunnel experiments, and building form and urban fabric studies have been conducted for integrating wind turbines into buildings. The relationship between building form and wind flow can directly influence the energy potential generated by the turbine. Furthermore, there are studies that examine the effects of roof form and building form on wind flow. The evaluation of the existing literature shows that changes in roof shape, façade form, and building shape are significant factors affecting a building's wind performance. These formal characteristics are also crucial for determining the position of turbines in integrated buildings to enhance energy efficiency.

This study will analyze the impact of roof form on wind flow, based on examples from the literature, and highlight the influence of formal characteristics that enhance wind flow on roofs. The study will provide guidance on how to increase the amount of energy generated by turbines in buildings with integrated wind turbines using renewable energy.

Keywords: *Energy Production, Wind Turbine, Sustainable Buildings, Wind Flow, Roof Form*

New Generation Architecture: Transcending the Conventional Boundaries of the Architect's Role

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Abstract

Architecture is a discipline that continuously evolves and expands its boundaries under the influence of technological advancements. Technology not only transforms the practice of architecture, including design, implementation and production processes, but also redefines the traditional role of the architect. The changing demands of the era, the acceleration of digitalization, and the pressures created by the sustainability crisis are among the dynamics that are reshaping the architect's role. Architecture is shaped by many parameters, including social, economic, cultural, technological, and environmental factors, in the human-centered design and construction process. Therefore, throughout history, the changing internal dynamics of different periods have led to variations in the definitions of architecture. The changing nature and boundaries of architecture have given the architect a flexible role that adjusts to different situations. This study aims to examine the effects of artificial intelligence on architectural practice, explore the role definition and skill sets of the new generation architect, and define the scientific and conceptual structure of the transformation process the architect is currently undergoing. The integration of artificial intelligence into design processes offers more creative solutions and innovative possibilities, while tools like Building Information Modeling (BIM) make design and construction processes more efficient. In this context, the role of the architect is being redefined—not only as a designer but also as a process manager, problem solver, and technology user. As the demand for conventional skills decreases and the architect's role is trimmed, opportunities arise for architects to take on new roles in emerging fields, leveraging their current knowledge, skills, and performance. With the growing digital expertise of architects and their ability to use technological tools effectively, the question of how to adapt to these changes points to the concept of next-generation architecture. The concept of next-generation architecture transcends traditional boundaries, redefining the role of the architect in a more collaborative, innovative, digital, and contemporary context. The impact of artificial intelligence-based design tools on the architect's creativity and the changes brought about by new platforms such as the metaverse in the role of the architect should be discussed within the context of the new generation of architecture. Expert intuition, the ability to make the right choices, seeing the big picture, sustainability, inclusivity, participatory approaches, conventional knowledge, compatibility, and transdisciplinarity are important characteristics of new generation architecture.. The digitalization of architectural practice and the integration of technology are radically changing the way architects work and placing new responsibilities on them. This transformation represents a significant area of inquiry into the skills and capabilities required of next-generation architects, as well as the learning and adaptation processes they must undertake. This transformation process creates an important area to discuss what skills and abilities the new generation architect should have and how they should go through a learning and adaptation process. In this context, topics such as the use of artificial intelligence in architecture, its potential effects, and future perspectives are also important parts of the study.

Keywords: *New Generation Architecture, Artificial Intelligence, Digitalization, Role of the Architect, Sustainability*

Breathing Straw-Bale Wall System

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Abstract

This study introduces an innovative, internationally patent-pending passive straw-bale wall and building system that incorporates a novel ventilation approach, termed the "breathing wall system" (Figures 1 and 2).[1]

In many passive house systems and energy-efficient buildings, heating or cooling systems may not be required due to high levels of insulation and proper building orientation in moderate climates.[4] However, automated ventilation systems with heat recovery are typically essential, as these designs prioritize "airtightness," a core concept of 20th-century energy-efficient architecture (Figure 3).

The term breathing in this context does not refer to the 20th-century concept of water vapor permeability in walls. Instead, it denotes the air permeability of the wall. The breathing wall system operates via small holes, approximately one millimeter in radius, located on the façade. These holes allow a controlled amount of exterior air to flow directly into the building interior. The number and size of these holes are optimized to regulate airflow rate and velocity, ensuring the preservation of interior comfort conditions. Furthermore, the wall envelope functions as a passive heat recovery system (Figures 4 and 5).[2]

Current research involves testing breathing wall systems with various materials, including concrete, timber, and glass, under laboratory conditions and on a small scale. The results have been promising, marking a significant paradigm shift compared to traditional 20th-century multilayered, airtight, energy-efficient façades.[3][5] However, implementing a façade with hundreds of small holes presents practical challenges, such as production complexity, vulnerability to dirt, dust, and water infiltration, acoustic weaknesses, and condensation issues. These challenges must be addressed for broader applicability (Figures 4 and 5). [3][5]

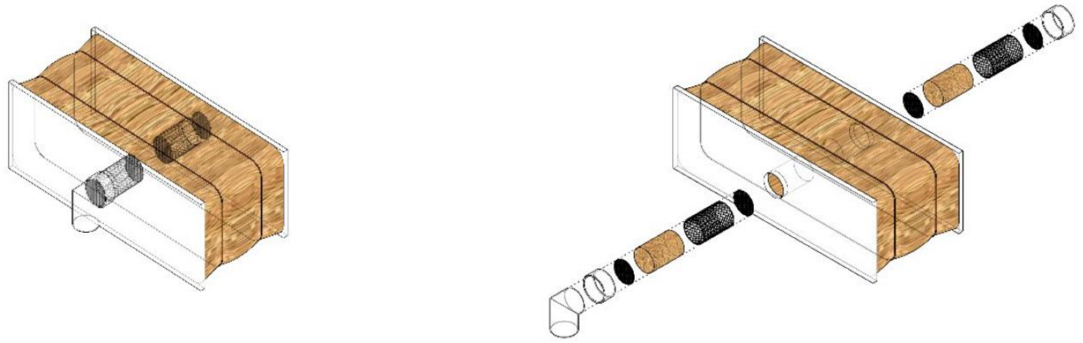

Figure :1,[1] Patented, innovative straw bale breathing wall system

While scientists have focused on conventional building materials, straw bales remain largely unexplored in this context. Straw bales, inherently porous by nature, possess a unique ability to facilitate airflow. By adjusting the material's thickness and density, it is possible to control the volume and velocity of air passing through the straw. Additionally, a patented breathing wall apparatus allows the system to function on rendered surfaces, mitigating risks such as dirt accumulation, rainwater infiltration, and other common operational challenges (Figures 1 and 2).[1]

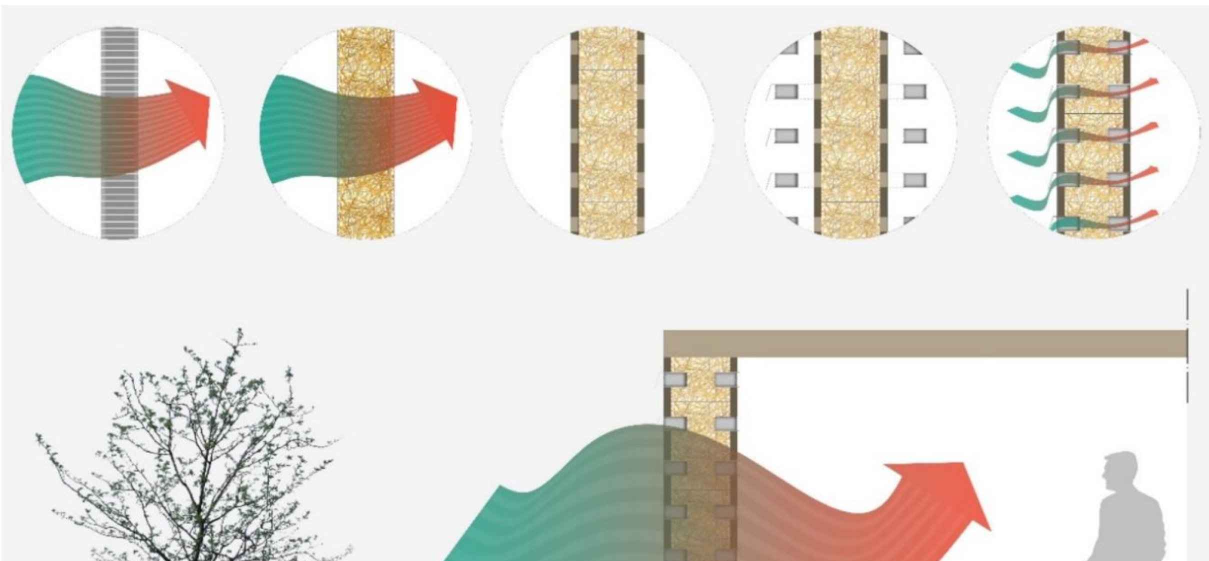

Figure:2

Integrating the breathing wall system with a straw-bale wall system offers the potential to significantly reduce or even eliminate the need for mechanical HVAC systems. This innovation moves us closer to achieving "zero-energy buildings" and "carbon neutrality" throughout the operational lifespan of a structure.

The SBWNV system represents a groundbreaking envelope design and provides an innovative passive climate-control solution for sustainable architecture.

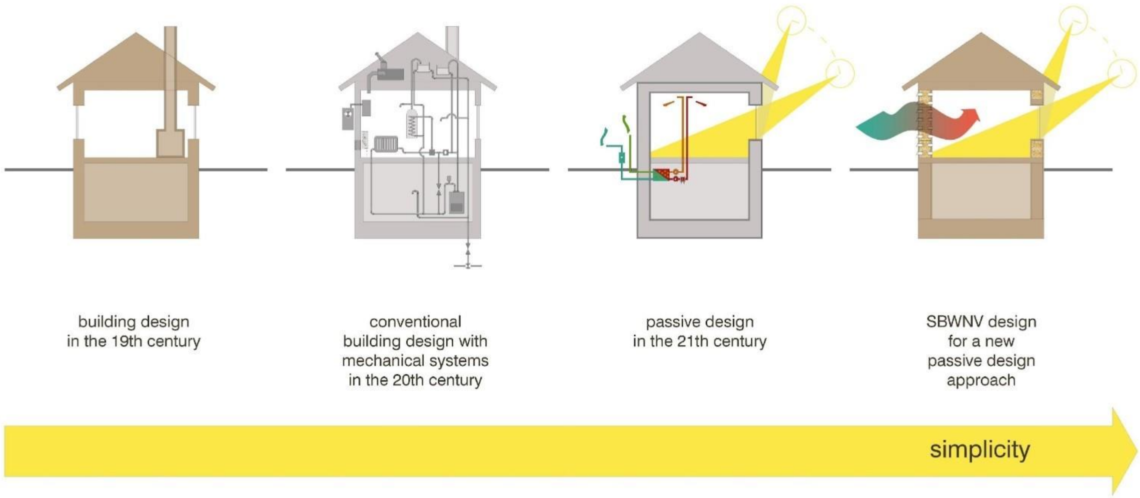

Figure:3

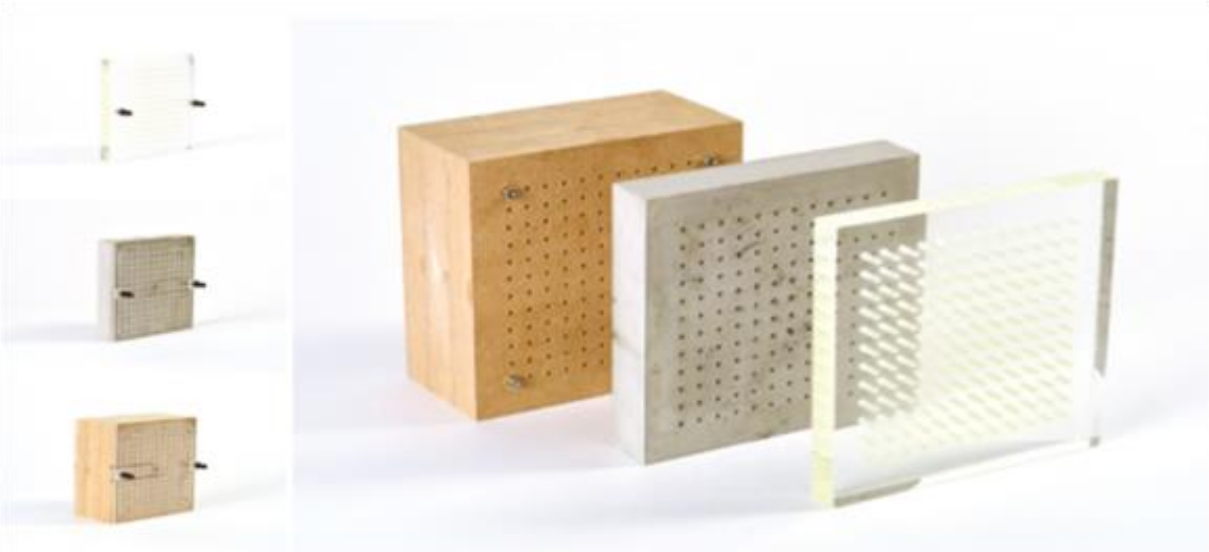

Figure:4, [2]

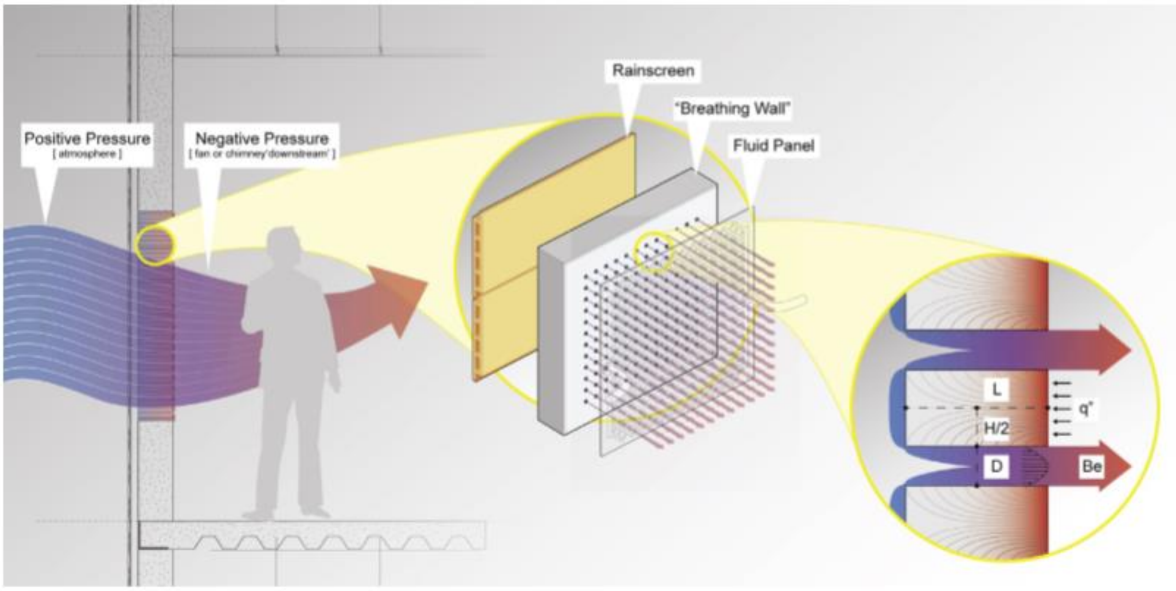

Figure:5,[3]

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Integration of Decision-Making Approaches with Life Cycle Assessment: A Systematic and Bibliometric Analysis for Sustainable Material Selection

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Abstract

The integration of sustainability principles into the construction industry has become a critical focus for reducing environmental impacts, improving resource efficiency, and contributing to the fight against climate change. In this context, life cycle assessment (LCA) and decision-making approaches enable sustainable material selection and guide industry practices in line with environmental goals. Innovative methods used in decision-making processes in the sector not only reduce environmental impacts but also support economic and social sustainability objectives. This study aims to comprehensively analyze decision-making approaches integrated with life cycle assessment for sustainable material selection. A bibliometric and systematic analysis will be conducted through a literature review in the Web of Science Core Collection, Scopus, and TR Dizin databases. The study will examine multiple decision-making methods, artificial intelligence-supported approaches, and other techniques used for sustainable material selection in detail. Additionally, the applications, advantages, and limitations of these methods in the architecture and construction sectors will be evaluated. Specifically, the contribution of artificial intelligence to decision-making processes will be explored for its potential to produce faster and more accurate results. The bibliometric analysis aims to comprehensively reveal research trends, key keywords, prominent authors, recurring concepts, applied methods, fields of study, and the geographical distribution of publications in this field. The findings will contribute to a better understanding of the current state of sustainable material selection and decision-making approaches in the industry. Furthermore, this study aims to fill gaps in the literature by offering concrete suggestions for future research. In this context, the study serves as an essential guide to environmental improvements in the architecture and construction sectors by demonstrating the effectiveness of life cycle assessment and decision-making approaches in achieving sustainability goals. Ultimately, this research will shed light on the development of methods that enhance environmental and economic sustainability in the sector.

Keywords: *Life cycle assessment, decision-making, sustainable material selection*


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